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# PATENT APPLICATION

# METHOD OF SHARING TELECOMMUNICATIONS NODE EQUIPMENT FACILITIES

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# METHOD OF SHARING TELECOMMUNICATIONS NODE EQUIPMENT FACILITIES

## CROSS-REFERENCES TO RELATED APPLICATIONS

**[0001]** The present application is a non-provisional of and claims priority from U.S. Provisional Application No. 60/455682, Attorney Docket No. 010327-007800US, filed March 17, 2003, the entire contents of which are herein incorporated by reference for all purposes.

## BACKGROUND OF THE INVENTION

**[0002]** The present invention generally relates to telecommunication equipment and more specifically to apparatus and methods for providing a plurality of logical telecommunication nodes in a telecommunication node.

**[0003]** A telecommunications node is designed to facilitate connections between two or more network end devices. The end devices may be devices such as telephones, computers, point of sale terminals, and other similar or related equipment. The end devices may be directly connected to the node or may be attached to other equipment that is subsequently connected to the node.

**[0004]** A telecommunications node is typically made from several components or subassemblies. For example, a telecommunications node includes a shelf with several slots for data processors that transfer data for the connections. Also, the data processors are controlled by a single control processor that manages the connections that are transferring data through the data processors.

**[0005]** A single telecommunications node is typically associated with one service provider. A service provider includes any entity that transfers data using the telecommunication node. Thus, the data transferred through the telecommunications node is associated with only that service provider. When the service provider does not transfer enough data in order to fully use the data processors in the telecommunications node, the node is not being used efficiently because data from other service providers cannot be transferred by the unused data processors.

**[0006]** Also, because a single control processor is typically found in one slot of the telecommunications node, it is not possible to use multiple control processors for the data processors. Typically, the control processor can only manage connections for a single service provider; thus, the telecommunications node is limited to processing data for a single service provider.

## BRIEF SUMMARY OF THE INVENTION

**[0007]** Embodiments of the present invention relate to providing a plurality of logical nodes in a telecommunications node. A plurality of control processors are configured to manage data routing paths for the logical nodes. Each logical node can be associated with a different entity.

**[0008]** In one embodiment, a telecommunications device for processing data is provided. The device includes a plurality of data processors. The device comprises: a plurality of control processors, each control processor configured to manage data routing paths for routing data between data processors in the plurality of data processors; and a plurality of logical nodes, wherein each logical node includes one or more data processors in the telecommunications device and is associated with a control processor in the plurality of control processor, wherein a logical node routes data using the one or more data processors included in the logical node according to the data routing paths for routing data associated with each logical data processor.

**[0009]** In another embodiment, a telecommunications shelf including a plurality of slots configured to connect to data processors is provided. The shelf comprises: a first logical shelf including a first set of one or more data processors, wherein each data processor in the first set is connected to a first set of one or more slots in the plurality of slots; and a second logical shelf including a second set of one or more data processors, wherein each data processor in the second set is connected to a second set of one or more slots in the plurality of slots, wherein the first logical shelf is associated with a first entity that transfers data using the first set of one or more data processors and second logical shelf is associated with a second entity that transfers data using the second set of one or more data processors.

**[0010]** In yet another embodiment, a method for routing data using a telecommunications device that includes a plurality of data processors is provided. The method comprises: configuring a first set of one or more data processors in the plurality of data processors for a

first logical node in the telecommunications device; configuring a second set of one or more data processors in the plurality of data processors for a second logical node in the telecommunications device; receiving data associated with a first entity; routing the data using the one or more data processors in the first logical node; receiving data associated with a second entity; and routing the data using the one or more data processors in the second logical node.

**[0011]** A further understanding of the nature and advantages of the invention herein may be realized by reference of the remaining portions in the specifications and the attached drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0012]** Fig. 1 depicts a simplified block diagram of a telecommunications system according to one embodiment of the present invention;

**[0013]** Fig. 2 depicts a simplified block diagram of a telecommunications node according to one embodiment of the present invention;

**[0014]** Fig. 3 illustrates a flow chart and a method for partitioning logical nodes in shelf according to one embodiment of the present invention; and

**[0015]** Fig. 4 illustrates a simplified flow chart of a method for transferring data for a logical node according to one embodiment of the present invention.

## DETAILED DESCRIPTION OF THE INVENTION

**[0016]** Fig. 1 depicts a simplified block diagram of a telecommunications system 2 according to one embodiment of the present invention. Telecommunications system 2 includes user devices 4, access equipment systems 6, a network 10, and telecommunication nodes 12.

**[0017]** User devices 4 are computing devices associated with users that communicate data. Examples include personal computers (PCs), customer premise equipment (CPE), user terminals and modems, workstations, personal digital assistants (PDAs), cellular phones, personal PCs, switches, servers, point of sale terminals, telephones, and the like. The data are transmitted to access equipment systems 6 through communication lines.

**[0018]** Access equipment systems 6 aggregate and multiplex the data received from user devices 4. Examples of access equipment systems 6 include digital subscriber line access

multiplexer (DSLAM), multiplexers, etc. Data received at access equipment systems 6 are then sent to routers 8. Data from a single access equipment system 6 are typically sent in a specific data format and a specific data rate. For example, the data formats include SONET/SDH (OC3, OC12, OC48, etc.), DS3/E3, Ethernet, Gigabit Ethernet, etc. Data in these formats are also transferred at various data rates, where a fixed data rate is associated with a format. Also, the type of physical connection may limit the data rate in which data is transferred. For example, ATM circuits may transfer data at one rate and SONET networks may transfer data at another rate.

**[0019]** Telecommunication nodes 12 receive the data from access equipment systems 6. Telecommunication nodes 12 process the data in data packets and may send the data packets to one or more other telecommunications nodes 12. Although data packets are referred to, it will be recognized that data may be transferred by other means, such as analog data through a public switched telephone network (PSTN). Data packets are then sent to either another access equipment system 6 and/or to another user device 4 through network 10. Network 10 may be any network, such as the Internet, a wireless network, a wireline network, etc.

**[0020]** Telecommunications nodes 12 comprise switches that transfer data between entities in system 2. For example, telecommunications nodes 12 transfer data between a first user device 4 to a second user device 4.

**[0021]** Fig. 2 depicts a simplified block diagram of a telecommunications node 12 according to one embodiment of the present invention. Telecommunications node 12 includes one or more data processors 201, a plurality of control processors depicted as control processor 202 and control processor 204, and a power supply 206. In one embodiment, a shelf 200 is a physical unit that is configured to house the one or more data processors 201.

**[0022]** Shelf 200 includes a plurality of slots labeled 1, 2, 3, 4, 5, . . ., X. Each slot is configured to hold a data processor 201. Additionally, shelf 200 includes an area for power supply 206. Power supply 206 is configured to power components for shelf 200. Although one power supply 206 is shown, it will be understood that any number of power supplies 206 may be used. Although control processors 202 and 204 are shown outside of shelf 200, it will be understood that control processors 202 and 204 may be included in shelf 200.

**[0023]** Data processors 201 include any data processor or data plane configured to transfer data. For example, data processors 201 include switching circuitry components that are included on a printed circuit board. In one embodiment, each data processor 201 includes a

number of ports 208 that are used to transfer data from one port 208 to another port 208. For example, data may be transferred from a port 208 in one data processor 201 to a port 208 in the same data processor 201 or a different data processor 201 in shelf 200.

**[0024]** Control processor 202 and control processor 204 are computing devices configured to manage the connections through data processors 201. For example, data routing paths between entities are included and managed by control processor 202. A data routing path may indicate that data should be routed from a data plane 201 in a slot #1 to a data processor in a slot #2. Additionally, data routing paths may also specify ports such as route data from a data processor #1, port #2 to a data processor #2, port #4.

**[0025]** Within telecommunication node 12, a plurality of logical nodes are formed using one or more data planes 201. Data processors 201 may be referred to by their slot numbers. For example, a data processor in a slot #1 is referred to as "data processor #1". In one example, a logical node #1 is formed with data processors #1 and #2 and a logical node #2 is formed with data processors #3, #4, and #5. In one embodiment, a logical node is a telecommunications node in itself. For example, in shelf 200, each logical node can transfer data for a different service provider. Thus, multiple service provider may transfer data through telecommunication node 12. Each logical node is associated with a control processor, as shown, control processor 202 is associated with logical node #1 and control processor 204 is associated with logical node #2.

**[0026]** As shown, a logical node #2 does not start at a physical slot #1. Data routing paths may be generated assuming that the logical node starts at slot #1. Control processor 204 is configured to determine how to route data between data processors 201 in logical node #2. Conventionally, if a telecommunications node included all slots in shelf 200, data routing paths for transferring data from a first data processor to a second data processor by slot number were easily configured by a control processor. However, in embodiments of the present invention, because a logical node may begin at any slot number, a control processor is configured to determine how to route data based on data routing paths that may assume a shelf 200 includes a single telecommunications node 12 and data routing paths start at a physical slot #1. For example, routing paths may specify that data should be routed from a data processor found in slot #1 to a data processor found in slot #2. If this routing path is used for routing data in logical node #1, no translation is necessary because the data processors are located in slots #1 and #2 for logical node #1. Data can be routed from data

processor #1 to data processor #2 as the data routing path indicates. However, for logical nodes that do not start at slot #1, a control processor is configured to map the data routing path to the slot numbers for the data processors found in the logical node. For example, control processor 204 may route the source of the data routing path from data processor #1 to data processor #3 and the destination from data processor #2 to data processor #4.

**[0027]** Fig. 3 illustrates a flow chart 300 and a method for partitioning logical nodes in shelf 200 according to one embodiment of the present invention. In step 302, partitions for logical nodes in shelf 200 are determined. A logical node may include one or more data processors 201 in shelf 200. Each logical node may have its own data processors 201, however, it will be understood that a logical node may share one or more data processors 201. The partitions will include data processors 201 found in certain slots, such as slots #1-2 for a first logical node and slots #3-5 for a second logical node.

**[0028]** In step 304, for each logical node determined, the physical locations in shelf 200 for data processors 201 in each logical node are determined. For example, for logical node #1 in Fig. 2, data processors #1 and #2 are found in slots #1 and #2. And for logical node #2, data processors #3, #4, and #5 are found in slots #3-5.

**[0029]** In step 306, each logical node is configured based on the physical location where its data processors are located. For example, a logical node is configured in that a control processor is configured to translate data routing paths based on its associated data processors. For example, if all data routing paths are based on a telecommunications node starting at a slot #1 in shelf 200, a control processor for a logical node that does not start at slot #1 is configured to map data routing paths to the physical locations of its data processors 201 in the physical slot numbers.

**[0030]** In one embodiment, each control processor includes a physical connection to a data processor 201 in shelf 200. From the connections, a control processor can determine the first data processor 201 in its logical node. For example, the control processor may be connected to the first data processor 201 in its logical node. Each control processor is configured to assume that the first data processor in the logical node is like a data processor 201 in the first slot. Thus, when a data routing path that assumes that data processors start at a first slot is encountered, the control processor maps the source of the data routing path to the first data processor that it is connected to and then maps the destination to a corresponding data processor in its logical node.

**[0031]** Once the logical nodes are partitioned, data is transferred for each logical node. Fig. 4 illustrates a simplified flow chart 400 of a method for transferring data for a logical node according to one embodiment of the present invention. In step 402, data is received for a data routing path associated with a logical node in shelf 200. The received data routing path may specify that data should be routed from a first data processor in a first slot number to a second data processor in a second slot number.

**[0032]** In step 404, a location of a logical node in shelf 200 is determined. For example, a logical node may include the data processors 201 found in slots #3-5 of shelf 200. The physical location (e.g., the slot numbers of data processors 201 for the logical node) is determined in shelf 200. Because each logical node does not start at slot #1, a location is determined in order to map data routing paths to the location of the logical node in shelf 200.

**[0033]** In step 406, the data routing path is mapped based on the location of the logical node in shelf 200. For example, if the data routing path is from a data processor #1 in slot #1 to a data processor #2 in slot #2, the data routing path may be mapped to a data processor #3 in slot #3 to a data processor #4 in slot #4 if logical node #2 of Fig. 2 is used. Thus, a data routing path that specifies that data should be routed from a first data processor in slot #1 to a second data processor in slot #2 is rerouted to the first and second data processors in a logical node #2. These data processors are not the first and second data processors in the first and second physical slots of shelf 200 but are the first and second data processors in the logical node.

**[0034]** In step 408, the data is routed to the determined physical shelf location according to the data routing path. In the above example, the data will be routed from data processor #3 to data processor #4.

**[0035]** Accordingly, embodiments of the present invention enable multiple logical nodes to be created in a telecommunication node. Thus, a physical shelf can include multiple telecommunication nodes and each telecommunication node can be associated with a different entity. Also, a control processor is associated with each logical shelf and each control processor is configured to map data routing paths to the physical location of data processors in the logical node.

**[0036]** While the present invention has been described using a particular combination of hardware and software implemented in the form of control logic, it should be recognized that other combinations of hardware and software are also within the scope of the present

invention. The present invention may be implemented only in hardware, or only in software, or using combinations thereof.

**[0037]** The above description is illustrative but not restrictive. Many variations of the invention will become apparent to those skilled in the art upon review of the disclosure. The scope of the invention should, therefore, be determined not with reference to the above description, but instead should be determined with reference to the pending claims along with their full scope or equivalents.